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ABSTRACT

The U.S. Army Reserve Officers' Training Corps (ROTC) administered basic skills achievement tests to cadets enrolled in Military Science I (MSI) and Military Science IV (MSIV): Missouri College English Test, Nelson-Denny Reading Test, and Stanford Achievement Test: High School Mathematics. The samples adequately represented geographic regions and genders. In addition, data were gathered on racial and ethnic groups: Asian or Pacific Islander, Black, Hispanic, Caucasian, American Indian, native Alaskan, and other. The purpose of the testing program was to analyze achievement test data and to report findings that might be used by ROTC to develop diagnostic and screening standards. The results indicated that females scored higher than males in English; males scored higher in mathematics; and there were no substantial differences in reading. On all tests, the ethnic minority groups scored lower than Caucasians, with substantial differences for Blacks and Hispanics. The mean scores of MSI cadets were consistently lower than those of MSIV cadets. Although further research was recommended in order to establish cutting score standards for potential officers, it was noted that about 20% of MSI cadets might profit from remedial instruction in English and reading. (Author/GDC)

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Research Report 1429

ROTC Achievement Testing Program: School Years 1983–1985

Fumiyo T. Hunter

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The Office of the Deputy Chief of Staff for Reserve Officers' Training Corps administered English, reading, and mathematics tests to Military Science I (MS I) and MS IV cadets to develop systematic information for formulating diagnostic and selection standards. The Army Research Institute analyzed the data. This report describes the score distributions for each MS class by gender, ethnic group, and academic major. There was little difference between average scores of males and females. However, the scores varied substantially
(continued)

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20. (Continued)

among ethnic groups. The findings indicate that further information is needed before diagnostic and selection standards using these or other achievement tests can be set.

Research Report 1429

ROTC Achievement Testing Program: School Years 1983-1985

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The Leadership and Management Technical Area of the Army Research Institute for the Behavioral and Social Sciences (ARI) conducts research addressing the issues of Army leader assessment, training, and performance. Since nearly 75% of new officers commissioned each year are trained through the Army Reserve Officers' Training Corps (ROTC), research on the ROTC training program has great potential for enhancing officer performance.

In 1983, the Deputy Chief of Staff for ROTC initiated the Achievement Testing Program to assess the levels of basic skills of ROTC cadets with the objective of developing standardized diagnostic and selection procedures. ARI was asked to perform the data analysis.

This report describes the results of the analyses in terms of the distribution of achievement test scores for Military Science I (MS I) and MS IV classes as a whole and for subgroups of cadets. The report also indicates additional types of information needed for ROTC to formulate diagnostic and selection standards as well as the organizational, social, and political issues that must be addressed in this process.

EDGAR M. JOHNSON
Technical Director

EXECUTIVE SUMMARY

Requirement:

The 1978 report of the Review of Education and Training of Officers (RETO) recommended a standardized screening procedure to be established for precommissioning programs. The Deputy Chief of Staff for ROTC (DCSROTC), Training and Doctrine Command (TRADOC), initiated a project to assess basic skills of ROTC cadets. The ODCSROTC requested the Army Research Institute (ARI) to analyze achievement test data for School Years 1983-85 and to report findings that might be used by ROTC to develop diagnostic and screening standards.

Procedure:

ROTC administered the Missouri College English Test, the Nelson-Denny Reading Test, and the Stanford Achievement Test: High School Mathematics Test to Military Science I (MS I) and MS IV cadets. Nearly the entire population of MS IV cadets participated, while the participation rate for MS I was a little better than 50%. However, for all classes tested, the proportional representation by region and gender closely approximated the percentage breakdowns for these subgroups of cadets reported by the ROTC Headquarters for the respective school years and MS classes.

This report is based on data from School Years (SYs) 1983-84 and 1984-85. The distributions of test scores were examined within each MS class by gender, racial/ethnic group, and academic major.

Findings:

Females scored higher than males in English; males scored higher than females in mathematics; and there were no substantial gender differences in reading scores. However, on all tests, the ethnic minority groups scored lower than the white group; the differences were substantial for the black and Hispanic groups. The average scores of MS I cadets were consistently lower than MS IV scores possibly due to attrition of lower achieving students, selection applied at contracting between MS II and MS III, and/or greater experience and education of MS IV cadets. Based on scores that might be used as possible cut scores for MS IV, the analyses identified about 20% of MS I cadets who might profit from remedial training in English and reading.

The academic majors were grouped as engineering/architecture, physical sciences, social sciences, and "other." The first three groups scored higher than the other group in all tests. The first three groups did not differ greatly in reading and writing skills, though the social science group scored lower than the other two groups in mathematics.

Utilization of Findings:

The data from this project provide comparisons of average test scores among subgroups of cadets. However, within the scope of this project, it was not possible to examine the relationship between precommissioning measures of academic achievement and officer job performance. In order to ensure adequate levels of basic skills of ROTC graduates and to meet the increasing officer production requirement, further research and considerations of organizational, social, and political issues are needed.

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ROTC Achievement Testing Program:
School Years 1983 - 1985

Background

An important aspect of precommissioning officer training is to ensure that all newly-commissioned Army officers have attained an adequate level of basic skills. The Army Reserve Officers' Training Corps (ROTC) produces nearly 75% of new officers commissioned each year, and this production mission is expected to increase in the coming years. The basic skills assessment and development effort in the ROTC program could make an important contribution to ROTC training effectiveness as well as officer utilization.

The 1978 report of the Review of Education and Training of Officers (RETO) recommended that a standardized method be established to screen and evaluate officer potential of candidates for precommissioning programs. The recommendation was followed by the Precommissioning Assessment System (PAS) (U.S. Department of the Army, 1978) which identified five components considered to be important to military leadership: academic, physical, medical, psychological, and leadership potential. PAS also established initial guidelines for assessing each of these components for the purpose of admitting, or contracting, cadets into ROTC Advanced Course.

The only standard currently used to assess cadets' academic competence for commissioning is a college degree and grade point average of 2.0 or above. However, grading standards vary greatly among universities and colleges. Thus, a need for further efforts in refining evaluation standards was reiterated in the 1984 report of Army Science Board Summer Study (U.S. Department of the Army, 1984).

Responding to this need, the Deputy Chief of Staff for ROTC (DCSROTC), the Training and Doctrine Command (TRADOC), initiated a project in 1983 to establish diagnostic and screening standards for standardized achievement tests. The plan was to administer achievement tests during three consecutive school years to ROTC cadets in Military Science I (MS I) and Military Science IV (MS IV) classes. Based on the configuration of the scores obtained from this initial phase of the project, ROTC was to formulate a standardized method of assessing and developing basic skills. ODCSROTC requested the Army Research Institute (ARI) to analyze the achievement test data for School Years (SY) 1983-86 to provide a description of cadet performance which would be used by ROTC in setting diagnostic and screening standards.

Objectives of the Achievement Testing Program

The Achievement Testing Program was designed to serve two purposes:

1. To establish guidelines for diagnosing basic skills deficiencies among cadets in the ROTC Basic Course (MS I and II) for the purpose of directing those with marginal or poor performance to receive remedial training.

2. To set criteria for proficiency in reading, writing, and mathematics for admissions to the Advanced Course of ROTC (MS III and IV) and for commissioning.

The immediate objective for the achievement testing in school years 1983 through 1986 was to establish an empirical basis for formulating preliminary standards for diagnosis, screening, and commissioning which might be adjusted when test results from subsequent years were examined.

Purpose of Report

The purpose of this report is to present results from the achievement test data analysis. It will describe test performance of ROTC cadets as a whole, comparisons among gender and ethnic subgroups, and how many cadets passed various score points.

Setting selection standards is a highly complex process. Besides the test scores, many other issues must be taken into consideration such as the relationships between basic skills and officer job requirements, the number of new officers needed, resources needed to continue testing, and the social/political implications of using cut scores for selection. Much of the information needed to address these issues is currently lacking, requiring further empirical research.

The results presented in this report will provide one of numerous pieces of information required, namely the test performance of ROTC cadets. However, they alone will not be sufficient to specify sound guidelines for selection or diagnostic procedures.

Procedure

Achievement Tests Used in the Project

ROTC selected three commercially available achievement tests to be used for this project. Each test provides national "norms," i.e., performance of a large sample of students across geographical areas, as a basis for comparison.

Missouri College English Test (Callis & Johnson, 1965). This test was designed to assess knowledge of "the mechanics and effectiveness of written expression" (Callis & Johnson, 1965, p. 3). It is a 90-item multiple-choice test, requiring no actual writing. The test was standardized based on data

from college freshmen attending universities and two- and four-year colleges, both private and public, from all regions of the United States, during the early 1960s.

Two issues need to be addressed in using this test: (1) The national norm was established for college freshmen only since the test was intended as a diagnostic tool to identify freshman students in need of remedial training in writing. When the test is administered to more advanced college students in higher college grades, as in the ROTC Achievement Testing Program, the interpretation of raw scores according to the national norms may be less accurate. Older students may be likely to score higher, due to greater experiences and learning opportunities and/or student attrition, part of which may be based on lack of basic skills.

(2) The original norming sample was adequate in number and regional and type-of-school representation. However, this was the only standardization performed for this test on a national sample. Since then, educational achievement levels have shifted (McGeever, 1983). It may, or may not, be accurate to judge writing abilities of the 80s students (even college freshmen) against the performance of freshmen in the early 60s. As described in the subsequent section, these problems were partially dealt with by computing ROTC norms based on the data collected for this project.

The Nelson-Denny Reading Test (Brown, Bennett, & Hanna, 1981). This test provides assessment of vocabulary knowledge, reading comprehension, and reading rate. The two subtests (Vocabulary, Comprehension) can be used selectively to diagnose students' weak areas. Scores from both subtests combined (Total) indicate their overall reading achievement.

The national norms for this test were developed in the late 70s, based on scores from students in 9th through 16th grades (high school and college). Separate norms are published for each of the 8 grades included, so that, for example, a college senior's score can be compared to a national sample of college seniors. Interpreting the ROTC students' performance against the national norm is more accurate with this test than with the Missouri English test, because the standardization was done fairly recently and separate norms for each college grade are available.

Stanford Achievement Test: High School Mathematics Test (Gardner, Merwin, Callis, & Madden, 1965). This test consists of three parts: a Numeric Competence subtest, which assesses students' general numeric and arithmetic capabilities; a Mathematics Part A subtest, which contains problems covered in high school elementary algebra and geometry textbooks, and a Mathematics Part B subtest, which tests knowledge of advanced algebra, trigonometry, and some new mathematics concepts from high school textbooks. For the purpose of diagnosis for remediation, the test writers suggest using the Numeric Competence subtest score.

The two problems mentioned with reference to the Missouri English test also apply to this test. The test was standardized based on students in high school grades (9th through 12th); the reference group which is closest to ROTC cadets is the college preparatory, high school seniors. In addition, the

norming data were collected in the early 60s. Thus, interpreting the performance of ROTC cadets, especially college juniors and seniors, according to these norms may not be very accurate.

Reliability and validity of the achievement tests. The reliability of these tests reported in the manuals are all in the .90s range and indicate adequate stability of scores on these tests. Table 1 presents the reliability coefficients and methods of deriving them for each test. The content validity, i.e., the degree to which test items cover the subject matter, was investigated by test developers for each test and reported to be satisfactory. However, the question of how accurately these tests may predict college graduates' job performance, specifically in the military setting, has not been addressed empirically.

Table 1
Reliabilities of Achievement Tests*

Test	Reliability Coefficient	Sample Grade	Sample Number	Method Used
Missouri College English Test	.94	13th	12,580	Split-half corrected by Spearman-Brown
Nelson-Denny Reading Test (Total scores)	.93	13th & 14th	239	Alternate forms correlations
Stanford-Mathematics		12th	4,897	Split-half
Numeric Competence	.92			corrected by
Mathematics Total	.94			Spearman-Brown

* Extracted from Callis and Johnson (1965) for English, Brown et al. (1981) for reading, and Gardner et al. (1965) for mathematics tests.

Test Administration Procedure

The ROTC-wide administration of the three achievement tests for the purpose of developing diagnostic and screening standards was carried out over three consecutive school years beginning with SY 83-84. During SY 83-84, the English and the reading tests were administered in the spring semester to MS IV classes of mostly juniors and seniors. In addition, the reading test was given to MS I cadets, mostly freshmen. In SY 84-85, the English and the reading tests were administered to MS I and IV classes in the spring. The

mathematics test was administered in the Advanced Camp during the summers of 1984 and 1985. In the last year of the research project (SY 85-86), data for English and reading were collected from MS I and MS IV cadets in the fall.

This report is based on data from the first two years. Table 2 presents the data collection schedule, the military science classes included, and the number of cadets who participated in the testing.

Tests were administered by the cadre in each ROTC detachment and then forwarded to the test publishers for scoring. The coded data on magnetic tapes were sent to ARI from ROTC Headquarters for analysis.

Table 2
ROTC Achievement Testing Program
Testing Schedule and Number of Cadets Tested

Tests and Time of Administration		Class MS I	MS III	MS IV
SY 83-84	Spring Semester			
	Nelson-Denny Reading	20,218		7,524
	Missouri English			7,365
	Summer Advanced Camp			
	Stanford Mathematics		8,221	
SY 84-85	Spring Semester			
	Nelson-Denny Reading	18,930		7,306
	Missouri English	16,001		7,558
	Summer Advanced Camp			
	Stanford Mathematics		8,265	

Demographic Description of Cadets Participating in the Achievement Testing Program

Tables 3 and 4 present the total number of cadets taking each of the achievement tests during the two school years and the percentages of subgroups by ROTC region, gender, racial/ethnic groups, and academic major categories.

Table 3 describes the MS I students who took the English test in SY 84-85 and the reading test in SYs 83-84 and 84-85. The total number of cadets included in each of these data sets represents approximately half of the end-of-school-year MS I enrollment for the respective years. The breakdown of cadets across ROTC regions reflect the regional distribution of ROTC detachments; most of the cadets attend schools in Regions I, II, and III. (See Appendix 1 for the states included in each ROTC region.) For the test data, the regional representation remained fairly stable over the two years with one exception of some decrease in cadets from Region III in SY 84-85.

Cadets identified themselves into one of the following ethnic groups: (1) Asian/Pacific Islander, (2) black - Negro, not of Hispanic origin, (3) Hispanic, (4) white - Caucasian, not of Hispanic origin, (5) American Indian/native Alaskan, and (6) Other. In the analyses and tables reported below, the American Indian/native Alaskan group, representing about .5% of every data set, was combined with the Other group. In terms of racial/ethnic backgrounds, approximately 73% of MS I cadets were white, 21% black, 3% Hispanic, and 1.5% Asian/Pacific Islanders. For both school years, about 28% of the MS I cadets were females.

The mathematics test was administered in Advanced Camp to cadets who had completed MS III classes and were to begin MS IV in the fall. For the sake of simplicity, the Advanced Camp cadets who took the mathematics test and the MS IV cadets who took the English and the reading tests will be designated "MS IV" cadets in the remainder of this report.

The MS IV data sets included much higher proportions of the end-of-school-year enrollment figures, ranging from 88 to 100% with a mean of 96%. The largest proportion of MS IV cadets tested came from Region I followed by Regions II, III, and IV, conforming to the regional distributions reported in the ROTC Enrollment Reports. Compared to the MS I data, the relative representation of the MS IV cadets from Region IV was considerably greater, while the relative representation of Region III cadets was smaller.

Percentages of males and females in the MS IV data remained stable over the two school years at approximately 16% females and 84% males. However, compared to the MS I data, the relative proportion of females was reduced to nearly half, from about 28% to about 16%. This suggests that a large number of female cadets might not continue in the ROTC program at the contracting time.

The racial/ethnic backgrounds of the MS IV cadets were: 73-76% white, 16-18% black, 4-5% Hispanic, and 2% Asian-Pacific Islanders. The proportion of the black cadets was lower, and that of the Hispanics was slightly higher, than in MS I classes.

Table 3
Demographic Composition of MS I Cadets Participating
in the Achievement Testing Program (Percentage of Total Tested)

Group	Reading data SY 83-84 N=20,218	Reading data SY 84-85 N=18,930	English data SY 84-85 N=16,001
ROTC Region			
Region I	32%	36%	36%
Region II	29	32	29
Region III	32	25	26
Region IV	7	7	8
Gender			
Female	27	28	28
Male	73	72	72
Racial/Ethnic Group			
Asian	1	2	2
Black	22	21	20
Hispanic	3	4	3
White	72	73	73
Other	2	1	2
Academic Majors			
Engineer/Architect	13	12	12
Physical Science	15	14	14
Social Science	12	13	12
Medical	7	7	8
Other	54	55	54

Table 4
Demographic Composition of MS III and MS IV Cadets Participating in the Achievement Testing Program (Percentage of Total Tested)

Group	Reading SY 83-84 N=7,524	Reading SY 84-85 N=7,306	English SY 83-84 N=7,365	English SY 84-85 N=7,558	Math SY 83-84 N=8,221	Math SY 84-85 N=8,265
ROTC Region						
Region I	43%	44%	42%	43%	39%	43%
Region II	21	25	22	24	25	24
Region III	19	17	20	18	20	19
Region IV	16	15	16	14	16	15
Gender						
Female	16	16	16	17	15	15
Male	84	84	84	83	85	85
Racial/Ethnic Group						
Asian	2	2	2	2	2	2
Black	18	16	18	16	18	18
Hispanic	4	6	5	4	5	5
White	75	76	73	76	73	73
Other	1	1	2	2	2	2
Academic Majors						
Engineer/Architect	9	12	9	11	11	12
Physical Science	15	16	14	15	15	16
Social Science	32	30	31	28	28	27
Medical	4	4	4	5	4	4
Other	40	38	41	41	42	41

The proportions of cadets by academic majors are also indicated in Tables 3 and 4. Academic majors were grouped, guided by the grouping procedure used by the Military Personnel Center (MILPERCEN) Officer Distribution Division as follows: Engineering/architecture, physical science (computer science, physical science, natural science, math/statistics), social science (social science, psychology), medical (pre-med, nursing), other (business/accounting, management, education, letters, fine arts, and undeclared).

The engineer/architecture group made up about 10% of MS I and IV classes. Likewise, the percentage of cadets in physical sciences was fairly consistent, at about 15% of all classes tested. On the other hand, the percentage of social science majors differed; about 12% for MS I classes and about 30% for MS IV classes. The "Other" group constituted the majority, 55% for MS I classes and about 40% for MS IV classes. The pre-med and nursing students

were combined, even though their academic programs may differ substantially, since together they make up less than 10% of the ROTC population (basic and advanced courses), and many of them are commissioned through the special appointment avenue.

To summarize the demographic composition of the cadets participating in the achievement testing, the proportions representing the ROTC regions, genders, and racial/ethnic groups remained fairly constant over the two school years. Nearly the entire population of MS IV cadets participated. For MS I testing, the participation rate was a little better than 50%. However, for all of these classes tested, the proportional representation by region and gender closely approximated the percentage breakdowns reported by the ROTC Headquarters for the respective school years and MS classes. The differences between the sample subgroup percentages and the percentages reported in ROTC Closing Enrollment Reports ranged from 0 to 5 percent, averaging at 1.6 percent. Comparing the demographic compositions between the MS I and IV classes, some marked differences were noted. The proportions of females and black cadets were lower in MS IV than in MS I.

Results

Data used for analysis were: the total score for the Missouri College English Test, the total of the Vocabulary and Comprehension subtests for the Nelson-Denny Reading Test, and the Numeric Competence subtest score for the Stanford Achievement Test of Mathematics.

The results of the analysis are presented in terms of the actual score a cadet achieved on each test (raw score) and the ROTC and national percentile scores. The raw scores are not comparable across the three achievement tests; the maximum possible scores for English, reading, and mathematics are 90, 172, and 45, respectively. Since a given raw score (e.g., 138 on the reading test) in itself does not denote a certain level of competence, one might refer to the percentile scores based on national samples. A percentile score indicates the percentage of people who scored at or below a given raw score. However, using the published percentile scores of these tests to infer ability levels may not be appropriate since the English and the mathematics tests were normed on test scores of college freshmen and high school seniors, respectively, both in the early 1960s.

The ROTC percentile scores provide current, age-appropriate norms based on the same ROTC reference group across tests. Using the ROTC percentiles, it is possible to compare the relative positions of various subgroups, and also to compare individual performance across the three tests. For example, an English raw score of 37, a reading score of 92, and a mathematics score of 25 all correspond to the 20th ROTC percentile score for MS IV cadets for the respective tests. This means that 20 percent of MS IV cadets scored below these raw scores on these tests. On the other hand, despite the limitations of the published national percentile scores, they do provide some basis on which to compare the ROTC percentile scores against the performance of students in general. For this purpose, both percentile scores are presented in some of the tables.

The score distributions were highly similar over the two school years, as exemplified in Table 5. For the remainder of the report, tabular and written descriptions of the results will be based mainly on the SY 83-84 data. The MS IV test results will be presented first, followed by the MS I test results.

MS IV Achievement Test Results

This section describes the results of the mathematics testing in Advanced Camp (in the summer between the junior and the senior years) and the English and the reading testing of MS IV cadets in the spring. Analysis of these data was related to the issue of standards for contracting or commissioning. It was guided by the question of what scores might be used as selection criteria which would serve to retain the maximum number of cadets who possess sufficient basic skills to perform their duties as Army officers. The analyses were also directed at the differential effects that various cut scores might have on gender and ethnic subgroups.

It must be emphasized here that the results reported below are not intended to suggest or recommend any selection standard. The particular ranges of scores examined in the following sections were chosen only for illustrative purposes, i.e., to show the patterns of score distributions for the whole group and for subgroups.

Missouri College English Test. For this test, the maximum raw score is 90, and the national norm is based on college freshmen of the early 60s. As shown in Table 5, the average raw score for the total group was 50 for both years. Taking the SY 83-84 data, the average for females was somewhat higher than for males, 54 and 49, respectively. However, more substantial differences were found among the racial/ethnic groups. The black and Hispanic groups scored substantially lower than the white group.

Table 6 shows the number of cadets in these ethnic groups who scored at or above given scores on the English test. The figures in columns labeled n indicate the actual numbers of cadets scoring at or above a given score; the percentage in parentheses indicates the proportion of the subgroup (e.g., white, black) that scored at or above this score. The "total" column summarizes the results across the ethnic groups.

A raw score of 37 on the English test corresponds to the 20th MS IV percentile point (meaning that approximately 80% of the total MS IV group scored at or above this score). For SY 83-84, 88% white, 47% black, 58% Hispanic, and 75% Asian cadets achieved a score of 37 or higher. In other words, 20% of the total MS IV cadets failed to achieve this score, but some ethnic groups were represented disproportionately in this 20%.

Table 5
Average Raw and Percentile Scores for
Missouri College English Test, MS IV, SY 83-84 and SY 84-85

	SY 83-84				SY 84-85			
	Raw Score	SD*	Percentile Scores ROTC	National	Raw Score	SD*	Percentile Scores ROTC	National
Total	50	15	49.6	40.2	50	15	49.5	40.4
Gender								
Male	49	14	48.3	38.9	50	15	48.4	39.3
Female	54	15	56.5	46.7	53	15	55.2	45.7
Ethnic Group								
Asian	48	14	44.8	36.0	49	15	46.2	37.4
Black	38	13	26.5	20.6	38	13	26.0	20.4
Hispanic	41	15	33.3	26.3	43	14	35.0	27.8
White	54	13	56.8	46.2	53	13	55.6	45.5
Other	46	16	42.9	34.4	48	15	45.6	36.9

* Standard deviation of raw scores.

Table 6
Cumulative Number and Percentage of MS IV Cadets Scoring Above
Various Scores on Missouri College English Test by Ethnic Group

Raw Score	Percentile Scores ROTC	Percentile Scores National	White n (%)	Black n (%)	Hispanic n (%)	Asian n (%)	Other n (%)	Total n (%)
SY 83 - 84								
37	20	15	4737 (88)	629 (47)	213 (58)	116 (75)	101 (70)	5796 (79)
34	15	11	4929 (92)	747 (56)	240 (66)	121 (79)	109 (76)	6146 (84)
30	10	7	5116 (95)	914 (68)	270 (74)	137 (89)	116 (81)	6553 (89)
25	5	4	5269 (98)	1092 (82)	309 (84)	147 (95)	128 (89)	6945 (94)
21	2	2	5323 (99)	1190 (89)	330 (90)	149 (97)	133 (92)	7125 (97)
Total			5359 (100)	1336 (100)	366 (100)	154 (100)	144 (100)	7359 (100)

NOTE: The "Total" is less than the total number tested due to missing data.

Nelson-Denny Reading Test. The possible raw score range for this test is from 0 to 172. However, the national norm provides a fairly accurate basis to interpret the raw scores relative to the performance of a national sample since the norms were developed for each college grade in early 1980s.

The means for the total ROTC group remained stable over the two years at the raw score of 119. Table 7 shows that the average scores for males and females were very similar for this test, although large differences were found among the ethnic group means.

Table 7
Average Raw and Percentile Scores for
Nelson-Denny Reading Test, MS IV, SY 83-84

	Raw Score	SD*	Percentile Scores ROTC	National
Total	119	30	49.6	43.0
Gender				
Male	119	30	49.9	43.3
Female	117	32	48.6	42.4
Ethnic Group				
Asian	110	30	40.7	34.3
Black	87	26	21.1	16.0
Hispanic	96	34	30.8	25.6
White	128	24	57.5	50.8
Other	119	32	49.9	43.9

* Standard deviation of raw scores.

Table 8 displays the number of cadets, by ethnic group, passing various score points. For SY 83-84, at the ROTC 20th percentile (raw score of 92), 91% of white cadets passed, but 39% and 55% of the black and Hispanic cadets, respectively, passed. The performance of ethnic minority groups was generally poorer, when compared to the total group, on the Nelson-Denny Reading Test than on the Missouri English test.

Table 8
Cumulative Number and Percentage of MS IV Cadets Scoring
Above Various Scores on Nelson-Denny Reading Test by Ethnic Group

Raw Score	Percentile Scores ROTC	National	White n	(%)	Black n	(%)	Hispanic n	(%)	Asian n	(%)	Other n	(%)	Total n	(%)
SY 83-84														
92	20	14	5078	(91)	509	(39)	177	(55)	103	(72)	70	(74)	5977	(79)
86	15	10	5275	(94)	623	(47)	193	(60)	111	(79)	77	(82)	6315	(84)
77	10	5	5437	(97)	784	(60)	220	(68)	119	(84)	80	(85)	6677	(89)
64	5	2	5547	(99)	1031	(79)	252	(78)	129	(91)	88	(94)	7086	(94)
54	2	1	5591	(99)	1161	(88)	277	(85)	133	(94)	91	(97)	7294	(97)
Total			5607	(100)	1312	(100)	324	(100)	141	(100)	94	(100)	7524	(100)

Stanford Mathematics Test. As Table 9 shows, the overall raw score mean on this test was 32 (with the possible score range of 0 to 42). The national norms on this test are not very informative since they were developed in early 60s based on performance of college-preparatory high school seniors. Males performed considerably better than the females on this test. For SY 83-84, the respective ROTC percentile means were 51.3 and 39.4. Table 9 also shows the same pattern of ethnic group differences found with the other tests: blacks and Hispanics scored substantially lower than whites.

Table 10 indicates that about 80% of the total ROTC group scored above a raw score of 25. However, this group included 87% of the whites, 84% of the Asians, 44% of the blacks and 61% of the Hispanics.

Table 9
Average Raw and Percentile Scores for
Stanford Math Test, MS III, SY 83-84

	Raw Score	SD*	Percentile Scores ROTC	Percentile Scores National
Total	32.1	8.1	49.5	43.2
Gender				
Male	32.6	8.0	51.3	44.9
Female	29.0	8.5	39.4	33.2
Ethnic Group				
Asian	33.1	7.2	52.4	45.8
Black	24.7	7.6	24.6	19.0
Hispanic	28.1	8.0	35.3	29.0
White	34.2	7.0	56.8	50.4
Other	30.9	8.3	45.1	38.6

* Standard deviation of raw scores.

Table 10
Cumulative Number and Percentage of MS III Cadets Scoring Above
Various Scores for Stanford Mathematics Test by Ethnic Group

Raw Score	Percentile Scores ROTC	Percentile Scores National	White n (%)	Black n (%)	Hispanic n (%)	Asian n (%)	Other n (%)	Total n (%)
SY 83 - 84								
25	20	14	5231 (87)	663 (44)	271 (61)	128 (84)	112 (74)	6405 (78)
23	15	10	5456 (91)	796 (53)	307 (69)	136 (90)	122 (81)	6817 (83)
20	10	6	5712 (96)	1018 (68)	356 (81)	140 (93)	132 (87)	7358 (90)
17	5	4	5847 (98)	1228 (82)	397 (90)	145 (96)	139 (92)	7756 (94)
14	2	2	5924 (99)	1350 (90)	422 (95)	150 (99)	144 (95)	7990 (97)
Total			5979 (100)	1492 (100)	442 (100)	151 (100)	151 (100)	8215 (100)

Note: The "Total" is less than the total number tested due to missing data.

The gender and ethnic group scores across three tests. There were gender differences in two of the tests; females scored higher in English and lower in mathematics than males. The average of males' English scores was not far below the total average, mainly because males constituted close to 85% of the total group. However, the females' average mathematics score was considerably below that of the males.

The ethnic minority groups, especially the blacks and the Hispanics, scored substantially lower than the white group in all skill domains tested. For all ethnic minority groups, the percentage of cadets passing the 20th percentile point was the lowest for the reading test. For black cadets, 39%, 44%, and 47% passed the 20th ROTC percentile points of the reading, mathematics, and English tests, respectively.

Analysis of composite scores based on three tests. The objective of the Achievement Testing Program was to determine basic skills qualification standards. However, the realities of officer production mission and the extent of differential impact of selection standards on subgroups must be considered in this process. An individual's performance on any given test can fluctuate, so that it is not judicious to base a critical decision concerning his or her future career on one test score. In addition, many individuals do not have the same degree of competence in all skill areas, but rather perform better in one area than another.

Table 11 shows the similarities of individual performance on two tests, e.g., between English and reading scores. The higher the correlations, the more similar the performance on two tests. For the total group, English and reading test scores are highly correlated ($r = .70$), but the associations between English and mathematics and between reading and mathematics are only moderate ($r = .55$ and $.51$, respectively). Many of the correlations between the verbal tests (English and reading) and mathematics are in the .40s range for ethnic subgroups. These results suggest that some cadets might score above the cut score (e.g., 40th ROTC percentile) on one test but below the cut score on another, largely due to varying expertise in different skill areas.

Table 11
Correlations Between Achievement Test Scores

	English and Reading	English and Math	Reading and Math
Total	.70	.55	.51
White	.63	.46	.38
Black	.61	.45	.40
Hispanic	.68	.53	.52
Asian	.78	.48	.48
Other	.71	.77	.63

Note: ROTC percentile scores were used for these analyses. Math data from SY 83 - 84, MS III; English and reading data from SY 84 - 85, MS IV classes.

If several test scores are used to evaluate cadets' overall competence in basic skills, their strengths in one area may compensate for marginal scores in another. This effect is shown on Table 12, which displays (in the first three columns) the percentage of minority-group cadets passing the 10th and the 20th ROTC percentile scores for the three tests separately. The fourth column contains the percentages of cadets passing these points based on each cadet's average of the English and the reading ROTC percentile scores. The last column shows the percentages based on averages of each cadet's ROTC percentile scores on all 3 tests.

Table 12
Percentage of Minority-Group Cadets Exceeding the 10th and the 20th ROTC Percentile Points for Each Test and Combinations of Tests

	English Only	Reading Only	Math Only	English and Reading	English and Math	Reading and Math	All Tests
10th Percentile							
Black	66%	63%	68%	69%	75%	72%	75%
Hispanic	79	63	81	83	88	83	88
Asian	89	81	93	93	98	95	96
20th Percentile							
Black	46	40	44	48	50	49	50
Hispanic	59	46	61	66	77	67	77
Asian	75	67	84	75	89	86	87

Comparing the results for separate tests and those for averaged data indicate that the number of minority cadets who would pass a given cut point would increase if multiple test scores are considered together. For example, if the 20th percentile score on the English test alone were used as a selection standard, only 46% of the black cadets would pass. If composite scores based on all tests, or English and mathematics, were used, 50% would pass. For the black group, which constitutes about 20% of the total MS IV population, the difference of 4% or 5% currently amounts to 50-60 more cadets to be commissioned.

Based on general knowledge about ability testing and the empirical illustration made above, it seems that using a composite score for a selection procedure would have the following advantages:

1) Multiple test scores are more reliable than one to represent an individual's overall abilities.
2) Since many individuals have different areas of strengths and since a basic level of quantitative skills would be needed for many officer jobs, both skill areas should be assessed.
3) If the English and mathematics scores are included in the composite, the number of cadets passing the cut score is likely to increase.

4) By increasing the number of cadets passing, this approach would reduce the differential impact of selection process across the ethnic minority groups.

However, currently there is no sound information on how well any of the separate tests or composite scores would predict performance in Army officer jobs. Analyses reported above suggest that additional research needed to clarify these questions is warranted.

MS I Achievement Test Results

The purpose for administering the English and the reading tests to MS I cadets was to examine the score distributions for new cadets which would, in turn, provide a basis for establishing remediation guidelines. As with the MS IV data, it was not possible to determine what level of reading and writing abilities a given test score represented since there was no other measure of these skills with which the achievement test scores could be compared.

Given this constraint, the following steps were taken: 1) compare raw scores of MS I and IV cadets and 2) examine the number of MS I cadets performing near the score which may be used as a cut score for selection (contracting and/or commissioning). Raw scores were used for comparison since percentile scores of MS I and MS IV groups are based on different reference groups and are not comparable. The following comparisons are based on SY 84-85 data which included English and reading tests given to both MS I and IV classes.

Table 13 shows the average raw scores of MS I and MS IV classes on English and reading tests for each class as a whole, by gender, and by ethnic group. The MS IV averages are consistently higher than the MS I averages.

Table 13
MS I and MS IV Raw Score Means
(SY 84 - 85 Data)

	English		Reading	
	MS I	MS IV	MS I	MS IV
Total	46 (15)	50 (15)	101 (32)	119 (30)
Gender				
Male	45 (15)	50 (15)	102 (32)	120 (30)
Female	48 (16)	53 (15)	99 (32)	117 (32)
Ethnic Group				
Asian	47 (15)	49 (15)	101 (35)	111 (32)
Black	35 (13)	37 (13)	73 (26)	88 (27)
Hispanic	37 (16)	43 (14)	76 (35)	93 (34)
White	50 (14)	53 (13)	110 (28)	128 (24)
Other	43 (16)	48 (15)	95 (34)	121 (33)

Note: Score range for the English test is 0 - 90.
Score range for the reading test is 0 - 172.
Standard deviations are indicated in parentheses.

Table 14 displays the percentages of MS I cadets scoring at or above a hypothetical cut score for MS IV cadets. The raw scores of 37 and 93, for the English and the reading tests, respectively, were the scores at which 20% of MS IV cadets in SY 84-85 failed. This table also shows a smaller percentage of MS I cadets passing these hypothetical cut score points on both tests, across ethnic groups.

Table 14
Percentages of MS I and MS IV Cadets Passing a Given Score
on Missouri English and Nelson-Denny Reading Tests
by Ethnic Group (SY 84 - 85)

	Raw Score	White	Black	Hispanic	Asian	Other	Total
English							
MS I	37	80%	38%	46%	71%	61%	69%
MS IV	37	87%	46%	59%	75%	72%	78%
Reading							
MS I	93	71%	20%	31%	55%	50%	58%
MS IV	93	90%	40%	46%	67%	75%	79%

Note: English raw score of 37 and reading raw score of 93 are the scores that about 80% of MS IV cadets passed in SY 84 - 85.

It is difficult to determine why the MS IV group scored higher than the MS I group, especially since the data for the two groups are not longitudinal (i.e., not collected from the same group of people at two points in time). Part of the difference may reflect attrition of low achievers from colleges and ROTC programs between MS I and MS IV years. The attrition may be voluntary or due to selection applied at contracting time. The difference may also reflect more years of education and greater expertise on the part of the older cadets.

If these changes are the primary reasons for the score differences between MS I and MS IV cadets and if ROTC were commissioning the required number of new officers each year, then a special effort for remediation training may not be necessary. However, currently there is a need to increase the number of commissionees. If remediation programs could improve the basic skills of marginally achieving cadets, it would enlarge the pool of cadets available for commissioning.

An approach for establishing remediation guidelines. As mentioned earlier, there are no data available to determine the relationship between the achievement test scores and performance in officer jobs. In addition, since the Achievement Testing Program data are not longitudinal, the degree to which MS I students might increase their basic skills without special remediation training is not known. Given this situation, the only feasible way to develop preliminary guidelines for early remediation might be to use scores which might be chosen as selection criteria as reference.

As an illustrative example, suppose that a cut score is set at the raw score at which 80% of MS IV cadets pass. (Depending on the size of cadet pool and officer production requirements, the cut score might be higher or lower.) Even though the overall performance of the MS I cadets was lower than that of MS IV classes, it is assumed that by the time of selection (for contracting or commissioning), a cadet would be expected to pass the cut score point. It is also assumed that those who scored somewhat above the cut score at time 1 (say in MS I class) may not pass at a later time, since any individual's performance on a given test can fluctuate over multiple testing. Further, those who barely make the cut score would benefit from developing the basic skill. On the other hand, those who score somewhat lower than the cut score may also increase their skills through special training and pass the test the second time.

The question is what proportion of MS I cadets fall in the score range of "somewhat above" and "somewhat below" the cut score. For English and reading data from SY 84-85, the MS I cadets were grouped into these score categories, using as the "cut score point" the score where 80% of MS IV cadets passed. Table 15 shows the percentage breakdowns by test.

Table 15
Percentage of MS I Cadets in Score Ranges
Close to a Possible Cut Score (SY 84 - 85)

Raw Score Range	Percent
English	
44 and above	57
37 - 43	15
30 - 36	12
29 and below	17
Reading	
101 and above	50
93 - 100	9
80 - 92	14
61 - 79	15
60 and below	12

Note: English raw score of 37 and reading raw score of 93 are the scores that 80% of MS IV cadets passed in SY 84-85.

For English, 80% of MS IV cadets passed the raw score of 37 (the MS IV average was 50). About 15% of MS I cadets scored 37-43. About 12% of MS I scored 30 to 36. A score of 30 is at about the 10th percentile point for MS IV cadets and would be an extremely low score as a selection standard. Of course, students falling in the very low score category may possibly improve skills to pass the cut score, with good instructions and high motivation. But it appears particularly beneficial for cadets in the middle groups (somewhat above and below the cut point) to be strongly encouraged to seek remedial training.

For the Nelson-Denny reading test, the hypothetical cut score, based on 80% pass for MS IV Cadets (SY 84-85), is 93. The MS IV average is 119. The score range that might be considered for remediation training is from 80 to 100. About 23% of MS I cadets fall in this middle range. On this test, about 12% of MS I cadets scored 61 or below, which is the range where about 5% of MS IV cadets scored. It may be difficult for most students scoring in this range to improve their reading skills enough to pass 92.

Comparison of Average Scores by Academic Majors

Table 16 presents average raw and ROTC percentile scores for MS I and MS IV cadets by test and by academic major groups (i.e., engineering/ architecture, physical science, social science, medical, and other). Note that raw score averages allow comparisons between MS I and IV cadets, while the ROTC percentiles indicate the position of a given subgroup relative to the total MS class. The means of MS IV class were based on data from SY 83-84 and SY 84-85 classes combined.

Table 16
Average Raw and ROTC Percentile Scores by College Major

	Engineer/ Architect	Physical Science	Social Science	Medical	Other
Missouri English					
MS IV	(10)	(15)	(30)	(04)	(41)
Raw Score	52	52	51	54	48
ROTC Percentile	53	54	50	57	46
Nelson-Denny Reading					
MS IV	(10)	(16)	(31)	(04)	(39)
Raw Score	121	121	122	125	114
ROTC Percentile	52	52	53	55	44
Stanford Math					
MS III	(11)	(16)	(27)	(14)	(42)
Raw Score	37	34	30	33	31
ROTC Percentile	68	57	43	55	45
Missouri English					
MS I	(12)	(14)	(12)	(08)	(54)
Raw Score	50	48	48	49	44
ROTC Percentile	57	53	53	54	45
Nelson-Denny Reading					
MS I	(13)	(15)	(12)	(07)	(54)
Raw Score	110	103	106	103	96
ROTC Percentile	58	52	54	52	45

Note: Numbers in parentheses indicate percentage of each major group in respective MS class.
Medical category includes pre-med and nursing majors.

For both MS I and IV classes, average scores on the English test were fairly close among the engineering, physical, and social science groups; the group averages for all of these groups were 50th or above ROTC percentiles. The "Other" group, which makes up the majority, scored lower. For MS IV cadets, the reading averages of all groups except "Other" were very close, and substantially higher than the "Other" average. This pattern is generally repeated for the MS I data.

The mathematics test was given only to MS III cadets, and no basic and advanced course comparison was possible. However, this test revealed more striking differences among the academic major groups. Engineering/ architecture students scored, as a group, substantially higher than the physical science majors, who in turn scored higher than the social science and "Other" groups.

Recall that the main difference in the academic major compositions between MS I and IV classes was that the percentage of social science majors was greater in MS IV than in MS I. In MS IV, this group performed as well as the engineering and physical science groups on English and reading tests.

Summary and Conclusions

The ROTC Achievement Testing Program was designed to serve two purposes: 1) to establish guidelines for diagnosing weaknesses in basic skills and 2) to establish selection standards.

There were several constraints in the research design. Only achievement test data were collected, with no other measure of academic achievement to verify the meaning of scores on these tests. Coupled with outdated and/or age-inappropriate national norms, interpretation of the "goodness" of any given score was difficult. Different year groups of cadets were involved in testing each year so that changes from MS I to MS IV years could not be inferred.

Some of the major findings from the Achievement Testing Program are summarized below. However, with the lack of many other essential data, the findings reported in this report must be considered preliminary and partial with reference to the issues of diagnostic and selection standards.

ROTC norms enabled comparisons of achievement levels among subgroups. For both MS I and IV classes, gender differences were relatively minor, but there were considerable disparities among ethnic groups across all tests. Using composite scores, derived from averaging two or more test scores, may provide a way to assess overall achievement level across various academic domains, to increase some cadets' chances of meeting the selection criteria, and to contribute towards ROTC officer production mission.

About 20% of MS I cadets scored somewhat above or somewhat below a score that was arbitrarily selected as a possible cut score for selection. If these cadets are informed of selection standards early in their college career and seek additional training in their weaker areas, this may have a significant impact on the overall quality and the number of ROTC-trained commissionees.

Analyses of academic majors showed that the majority of cadets major in subjects other than engineering/architecture, physical, and social sciences and that they, as a group, scored lower than these groups. The engineering/ architecture and the two science groups did not differ greatly in reading and writing skills, though the social science group scored lower than the other two groups in mathematics.

Ensuring the basic competency of new officers is an essential mission of all precommissioning programs. However, the Army ROTC also has a mission to increase the number of commissionees during the next several years when a decline is expected in college enrollment. For example, ROTC projects commissioning 7,500 new officers in FY87 with the requirement of 9,200 (U.S. Department of the Army, 1986, in preparation). Even with a basic skills selection standard which disqualifies the lowest 10% of the prospective commissionees, the rate of production shortfall would increase from 18% to 27%.

In order to approach systematically the multiple objectives of ROTC, additional empirical research is needed. First, there must be a clear knowledge of which, and how much, basic skills are needed for Army officer jobs. Then, the effectiveness of basic skills development programs needs to be assessed. Issues to be addressed include: Which basic skills are amenable to developmental procedures? Which method is most effective and cost-effective? What levels of deficiencies are most likely to be improved? What are the rate and permanence of change?

One such effort was undertaken within the military context during the 60s and early 70s. The focus of this project was on functional literacy among the enlisted personnel and effectiveness of an experimental reading training program which was integrated into the military-job-skills training. In terms of job-related reading skills, a substantial improvement was obtained (Sticht, 1975a, 1975b).

Unfortunately, these findings are not directly applicable to college population, curriculum, and officer job requirements. In addition, although basic skills remediation programs are commonly offered at most colleges and universities, systematic information concerning their effectiveness is scarce. Thus, examining the effectiveness of developmental procedures seems warranted.

Finally, decisions regarding selection standards also must be based on officer job analysis and knowledge of predictive relationships between various basic skills measurements and officer job performance.

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APPENDIX 1

ROTC Region Jurisdiction

First ROTC Region, Fort Bragg, NC 28307

Connecticut	Maine	New York	Vermont
Delaware	Maryland	North Carolina	Virginia
District of Columbia		Massachusetts	Pennsylvania
Florida	New Hampshire	Rhode Island	Puerto Rico
Georgia	New Jersey	South Carolina	Virgin Islands

Second ROTC Region, Fort Knox, KY 40121

Illinois	Kentucky	Missouri	Tennessee
Indiana	Michigan	Ohio	West Virginia
			Wisconsin

Third ROTC Region, Fort Riley, KS 66442

Alabama	Kansas	Mississippi	Oklahoma
Arkansas	Louisiana	New Mexico	Texas

Fourth ROTC Region, Fort Lewis, WA 98433

Alaska	Idaho	Nevada	Washington
Arizona	Iowa	North Dakota	Wyoming
California	Minnesota	Oregon	Guam
Colorado	Montana	South Dakota	American Samoa
Hawaii	Nebraska	Utah	